Viking Era Morning and Afternoon Water Ice Clouds

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The degree to which water ice clouds play a role in the Mars climate is unknown. Latent heating of water ice clouds is small and since most hazes appeared to be thin ($\tau \leq 1$) (Kahn, 1990) their radiative effects have been neglected. Condensation likely limits the vertical extent of water vapor in the water column (Davies, 1979; Jakosky, 1985) and a lowering of the condensation altitude, as seen in the northern spring and summer (Jaquin, 1986), could increase the seasonal exchange of water between the atmosphere and the surface [1]. It has been suggested (Clancy, et al., 1996) that water ice cloud formation is more frequent and widespread in the aphelic hemisphere (currently the northern). This may limit water to the northern hemisphere through greater exchange with the regolith and through restricted southward transport of water vapor by the Mars Hadley circulation. In addition, it has been suggested (Clancy, et al., 1996) that water ice cloud formation also controls the vertical distribution of atmospheric dust in some seasons. This scavenging of dust may in turn cool the atmosphere further by removing the radiatively active dust. While aspects of this hypothesis are still being investigated and debated, the fact that clouds play a role in the climate of Mars is becoming more accepted. Whether or not clouds vary substantially on an interannual basis has been debated. Clancy et al. (1996) contrasted cloudiness during more recent cold northern spring and summers observed using ground-based microwave spectrometers with the supposedly warmer Viking period. The temperature differences found may be an artifact of the atmospheric temperatures derived from the Viking Infrared Thermal Mapper (IRTM) data set (Richardson, 1998; Wilson, 1999). However, if the atmosphere becomes colder, it is not certain that the clouds would become more spatially extensive. They may form at a lower altitude or they may condense out completely, leaving little water in the atmospheric column. Thus, the question of how the cloudiness differs through time and with atmospheric temperatures is still of interest.

Tamppari et al., (1999) provided a reanalysis of a portion of the Viking data to assess the water ice clouds during this time period. The identification of water ice clouds in the Infrared Thermal Mapper (IRTM) data set depends on properly removing the effect of non-unit, varying surface spectral emissivities (Christensen, 1998; Tamppari et al., 1999). They showed water ice clouds to be present to some extent in all seasons over the 1.25 Martian years. However, the analysis concentrated on only the mid-day time period, during which the atmospheric and surface temperature differences are likely the greatest. However, using the same technique, it is possible to identify the morning and afternoon water ice cloud extent as well. These additional times of day are important to better understand the extent of the cloudiness on Mars during the Viking era as well as examine potential time-of-day changes in cloudiness. We will present and discuss seasonal cloud maps for these two additional times of day.